CLAIMS:

~~1. A can end for a can for pressurized contents, the can end being configured to be joined by a peripheral annular joining portion to one axial end of a can body of the can and having an outer side arranged to face outwardly from the can and an inner side arranged to face inwardly into the can, the can end comprising:~~

~~a central panel;~~

~~a panel wall annularly surrounding the central panel and extending axially inwardly and radially outwardly from the central panel;~~

~~an annular chuck wall structure extending radially- and axially-inwardly from the joining portion; and~~

~~an annular bead which is connected between a radially outer edge of the panel wall and a radially inner edge of the chuck wall structure and which is concave with respect to the outer side of the can end and extends at least partially radially outwardly with respect to the radially inner edge of the chuck wall structure,~~

~~wherein wall portions adjacent inner and outer ends of the concave annular bead form a bead mouth that is open towards the outer side of the can end.~~

~~2. The can end of Claim 1, wherein said bead mouth is the point of closest approximation of the wall portions adjacent inner and outer ends of the concave annular bead.~~

~~3. The can end of Claim 1 or 2, wherein the annular bead exhibits a cross-sectional profile which, in a plane through the can end which includes a central axis of the can end, substantially inscribes a circle.~~

~~4. The can end of Claim 3, wherein the annular bead is open to the outer side in a direction radially inwardly and axially outwardly from the inscribed circle.~~

~~5. The can end of Claim 1, wherein, in a plane through the can end which includes a central axis of the can end, the adjacent wall portions forming the bead mouth are parallel or diverge from the inner and outer ends of the annular bead towards the outer side of the can end.~~

~~6. A can end for a can for pressurized contents, the can end being configured to be joined by a peripheral annular joining portion to one axial end of a can body of the can and having an outer side arranged to face outwardly from the can and an inner side arranged to face inwardly into the can, the can end comprising:~~

~~a central panel;~~

~~a panel wall annularly surrounding the central panel and extending axially inwardly and radially outwardly from the central panel;~~

~~an annular chuck wall structure extending radially- and axially-inwardly from the joining portion; and~~

~~an annular bead which is connected between a radially outer edge of the panel wall and a radially inner edge of the chuck wall structure and which is concave with respect to the outer side of the can end and extends at least partially radially outwardly with respect to the radially inner edge of the chuck wall structure,~~

~~wherein the annular bead exhibits a cross-sectional profile which, in a plane through the can end which includes a central axis of the can end, substantially inscribes a circle, and~~

~~wherein wall portions adjacent inner and outer ends of the annular bead form a bead mouth that is disposed axially outwardly and radially inwardly of the inscribed circle.~~

~~7. The can end according to Claim 6, wherein said bead mouth is the point of closest approximation of the adjacent wall portions nearest to the centre of said inscribed circle.~~

~~8. The can end of any preceding claim, wherein the panel wall is convexly curved with respect to the can end outer side,~~
~~wherein the chuck wall structure includes an annular chuck wall extending radially- and axially-inwardly, and the radially inner end of the annular chuck wall is connected to the annular bead via a portion which is convexly curved with respect to the can end outer side and which does not touch the outer side surface of the panel wall, and~~
~~wherein the can end is configured such that, when the can end is joined to a can body and internal pressure in the can is increased so as to cause the can end to bulge outwardly, the convexly curved panel wall will kiss against the convexly curved portion at the radially inner end of the annular chuck wall.~~

~~9. The can end of any preceding claim, wherein the annular bead exhibits a cross-sectional profile which, in a plane through the can end which includes a central axis of the can end, has a bead wall that is substantially continuously concavely curved through more than 180 degrees, and~~
~~wherein said concave bead wall terminates at its outer end at an angle with respect to the central axis of the can end of not less than 45 degrees, said angle being measured in the cross-sectional plane from the central axis in the outward direction to the tangent to the panel~~

~~wall at the radially outer end of the concave curvature in the direction of the bead wall moving from the central panel to the chuck wall.~~

~~10. The can end according to Claim 9, wherein the panel wall blends at its radially outer edge into the concave curvature of the annular bead, and wherein, in said plane through the can end, a tangent to the wall of the can end at the transition point between the convex panel wall and the concave annular bead, in a radially outward direction, is at an angle from the outer axial direction of not more than 150 degrees, measured in said plane.~~

~~11. The can end according to any one of Claims 1 to 8, wherein the panel wall is convexly curved with respect to the outer side of the can end, and blends at its radially outer edge into the concave curvature of the annular bead, which maintains a substantially constant curvature through more than 180 degrees, and wherein, in a plane through the can end which includes a central axis of the can end, a tangent to the wall of the can end at the transition point between the convex panel wall and the concave annular bead, in a radially outward direction, is at an angle from the outer axial direction of not more than 150 degrees, measured in said plane.~~

~~12. The can end according to Claim 9 or 11, wherein the annular bead is substantially continuously curved through more than 225 degrees.~~

~~13. The can end according to Claim 10 or 11, or Claim 12 as dependent thereon, wherein said angle of the tangent to the wall of the can end at the transition point from the axial outer direction is not more than 135 degrees.~~

~~14. A can end for a can for pressurized contents, the can end being configured to be joined by a peripheral annular joining portion to one axial end of a can body of the can and having an outer side arranged to face outwardly from the can and an inner side arranged to face inwardly into the can, the can end comprising:~~

~~a central panel;~~

~~a panel wall annularly surrounding the central panel and extending axially inwardly and radially outwardly from the central panel;~~

~~an annular chuck wall structure extending radially- and axially-inwardly from the joining portion; and~~

~~an annular bead which is connected between a radially outer edge of the panel wall and a radially inner edge of the chuck wall structure and which is concave with respect to the outer side of the can end and extends at least partially radially outwardly with respect to the radially inner edge of the chuck wall structure,~~

~~wherein said panel wall and said annular bead are integrally formed by reforming a blank by axially compressing it against an inner centre panel tool that has an axially inwardly and radially outwardly sloped surface extending from a central panel region and is provided at its peripheral radially outer edge with a curved annular recess facing the outer side, said curved annular recess thereby forming said annular bead.~~

~~15. A can end for a can for pressurized contents, the can end being configured to be joined by a peripheral annular joining portion to one axial end of a can body of the can and having an outer side arranged to face outwardly from the can and an inner side arranged to face inwardly into the can, the can end comprising:~~

~~a central panel;~~

~~a panel wall annularly surrounding the central panel and extending axially inwardly and radially outwardly from the central panel;~~

~~an annular chuck wall structure extending radially and axially inwardly from the joining portion; and~~

~~an annular bead which is connected between a radially outer edge of the panel wall and a radially inner edge of the chuck wall structure and which is concave with respect to the outer side of the can end and extends at least partially radially outwardly with respect to the radially inner edge of the chuck wall structure,~~

~~wherein the material of the can end is not folded or in contact with itself between the radially outer edge of the panel wall and the radially inner edge of the chuck wall structure.~~

~~16. A can end according to any preceding claim, further comprising a cover, label, token, tab or other material provided in the annular bead.~~

~~17~~1. A method of manufacturing a can end comprising:

reforming a blank by compressing an axially extending annular portion of the blank material that surrounds a central panel region of the blank to cause at least a radially inner portion of the annular portion to flow into and substantially adopt the shape of an annular recess provided on the opposite side of the central panel, in the axial direction, to the direction in which the annular portion initially axially extends; and

further reforming the blank under axial compression with at least the central panel region of the blank under tension.

~~18~~2. The method of Claim ~~17~~1, wherein reforming the blank includes axially compressing the annular portion against an annular tool surface extending

radially outwardly from the central panel region and curving axially away from the direction in which the annular portion of the blank initially axially extends and terminating in a concave annular recess that faces back towards the direction in which the annular portion initially axially extends, such that at least the radially innermost portion of the annular portion rolls radially outwardly around the annular tool surface from the radially outer edge of the central panel region to substantially adopt the shape of said annular tool surface.

~~19~~3. The method of Claim ~~17~~ 1 or ~~18~~2, wherein the annular recess includes at the radially outer edge thereof an annular concave portion facing axially outwardly and configured to promote the formation of an axially outwardly concave and radially outwardly extending bead portion.

~~20~~4. The method of Claim ~~17~~1, ~~18~~ 2 or ~~19~~3, wherein axially compressing the blank to cause at least the radially inner portion of the annular portion to flow into and substantially adopt the shape of the annular recess imparts a preliminary radially inward curve in a remaining portion of the annular portion that otherwise extends axially from the radially outer edge of the annular recess to an or the outermost peripheral portion of the blank that is held to facilitate said axial compression.

~~21~~5. The method of Claim ~~20~~4, wherein reforming the blank includes further axially compressing the blank to cause said preliminary radially inward curve in the remaining portion of the annular portion to further deform radially inwardly.

~~22~~6. The method of Claim ~~21~~5, wherein further axially compressing the blank includes supporting an

axially outer side of the remaining portion of the annular portion by an outer chuck wall tool, so that the axial outer end of the radially inwardly curved remaining portion is at least partially formed into at least part of a chuck wall of the end can by said further axial compression.

~~237~~. The method of any one of Claims ~~17~~ 1 to ~~226~~, wherein all of the reforming and further reforming is performed by a single motion to progressively axially compress and reform the annular portion of the blank.

~~248~~. A method of manufacturing a can end comprising:

reforming a blank by compressing an axially extending annular portion of the blank material that surrounds a central panel region of the blank against an annular tool surface extending radially outwardly from the central panel region and curving axially away from the direction in which the annular portion of the blank initially axially extends and terminating in a concave annular recess that faces back towards the direction in which the annular portion initially axially extends, such that at least the radially innermost portion of the annular portion rolls radially outwardly around the annular tool surface from the radially outer edge of the central panel region to substantially adopt the shape of said annular tool surface.

~~259~~. The method of any one of Claims ~~17~~ 1 to ~~248~~, further including axially drawing the blank by drawing an outermost peripheral portion of the blank in an axially outward direction relative to the central panel region of the blank in order to draw an intermediate annular portion of the blank such that it extends radially- and axially-outwardly from the central panel region to the outermost peripheral portion as said axially extending annular portion.

~~26~~10. The method of Claim ~~25~~9, wherein axially drawing the blank introduces a preliminary radially outward curve into the annular portion of the blank in the vicinity of the central panel region of the blank.

~~27. An inner centre panel tool for pressing against the inner side of a blank in the manufacture of a can end to reform the blank against said tool, the tool comprising an axially outwardly facing central panel region and a sloped peripheral surface extending axially inwardly and radially outwardly from the central panel region and terminating at its radially outer peripheral edge in a concave annular recess facing in the axially outward direction.~~

~~28. The tool of Claim 27, wherein said sloped peripheral surface curves gradually axially inwardly away from the central panel region in the radially outward direction to form said slope as a domed convex annulus.~~

~~29. The tool of Claim 27 or 28, wherein said concave annular recess is concavely curved.~~

~~30. Tooling for manufacturing a can end to be joined to one axial end of a can body of a can for pressurized contents, comprising:~~

~~an inner centre panel tool for forming the inner side of a can end corresponding to the inside of the can and arranged to be disposed concentrically within an inner wall tool so as to be substantially adjacent to a radially inside wall of the inner wall tool,~~

~~wherein said inner centre panel tool has a peripheral surface sloping axially inwardly in a radially outward direction from a central panel region of the inner centre panel tool, such that said peripheral surface together with said inside wall of the inner wall~~

~~tool defines an annular recess axially inwardly of the central panel region, and~~

~~wherein said annular recess is configured to promote the formation of a radially outwardly extending bead in a can end during a reform process of axially compressing a blank against the inner centre panel tool.~~

~~31. The tooling of Claim 30, wherein said peripheral surface is sloped relative to the axial direction across at least 25% of the radial width of said annular recess extending radially outwardly from said central panel region.~~

~~32. The tooling of Claim 30 or 31, wherein an axially outwardly facing concave annular recess is formed at the radially outer edge of the peripheral surface of the inner centre panel tool, so as, together with the inside wall of the inner wall tool, to promote said formation of the radially outwardly extending bead during the reform process of axially compressing a blank against the inner centre panel tool.~~

~~33. The tooling of Claim 30, 31 or 32, wherein said peripheral surface is convexly curved gradually axially inwardly away from the central panel region in the radially outward direction to form said slope as a domed convex annulus.~~

~~34. Tooling for manufacturing a can end to be double-seamed onto one axial end of a can body of a can, comprising:~~

~~inner tools for forming the can end on a side corresponding to the inside of the can and arranged to be disposed on an axially inner side of outer tools for forming the can end on a side corresponding to the outside of the can, including:~~

~~an inner centre panel tool;~~

an inner wall tool arranged concentrically surrounding and substantially adjacent to the inner centre panel tool;

an outer centre panel tool opposed to the inner centre panel tool; and

at least one outer wall tool generally opposed to the inner wall tool and arranged concentrically surrounding and substantially adjacent to the outer centre panel tool,

wherein the opposed inner and outer wall tools are able to move axially relative to the opposed inner and outer centre panel tools,

wherein the outer centre panel tool has a smaller outside diameter than the inside diameter of a radially inner wall of the inner wall tool, the outer centre panel tool being disposable concentrically at least partially within the inner wall tool to leave an annular gap radially surrounding the outer centre panel tool, and

wherein the inner centre panel tool includes a peripheral annular surface surrounding a central panel region of the inner centre panel tool and extending axially inwardly in a radially outward direction from the central panel region, the peripheral annular surface, together with the radially inner wall of the inner wall tool, defining an annular recess extending axially inwardly from the central panel region of the inner centre panel tool, said annular recess being substantially opposed to said annular gap.

35. The tooling of Claim 34, wherein the peripheral annular surface terminates at its radially outer end in an annular recess configured to promote the formation of a radially outwardly extending recess during a reform process of axially compressing a blank against the inner centre panel tool.

~~36. The tooling of Claim 34 or 35, wherein the at least one outer wall tool includes a chuck wall tool arranged concentrically surrounding and substantially adjacent to the outer centre panel tool and extending across the annular gap substantially opposed to the annular recess.~~

~~37. The tooling of Claim 36, wherein the chuck wall tool includes an axially inwardly facing annular surface opposed to the annular recess, said inwardly facing surface being sloped axially outwardly in the radially outward direction.~~

~~38. A can for pressurized contents comprising a can body having a can end joined to one axial end thereof, the can end being selected from the group consisting of:~~

~~the can end of any one of Claims 1 to 16;~~

~~a can end manufactured by the method of any one of Claims 17 to 26;~~

~~a can end made using the tool of any one of Claims 27 to 29; and~~

~~a can end made using the tooling of any one of Claims 30 to 37.~~

~~39~~11. A can end manufacturing apparatus configured to manufacture a can end according to the method of any one of Claims ~~17~~ 1 to ~~26~~10.

~~40~~12. The apparatus of Claim ~~39~~ 11 comprising:

an inner centre panel tool for pressing against the inner side of a blank in the manufacture of a can end to reform the blank against said tool, the tool comprising an axially outwardly facing central panel region and a sloped peripheral surface extending axially inwardly and radially outwardly from the central panel region and terminating at its radially outer peripheral edge in a concave annular recess facing in the axially outward direction.

13. The apparatus of Claim 12, wherein said sloped peripheral surface curves gradually axially inwardly away from the central panel region in the radially outward direction to form said slope as a domed convex annulus.

14. The apparatus of Claim 12 or 13, wherein said concave annular recess is concavely curved. ~~the tool of any one of Claims 27 to 29; and/or~~

15. The apparatus of Claim 11, 12, 13 or 14, comprising tooling for manufacturing a can end to be joined to one axial end of a can body of a can for pressurized contents, the tooling comprising:

an or the inner centre panel tool for forming the inner side of a can end corresponding to the inside of the can and arranged to be disposed concentrically within an inner wall tool so as to be substantially adjacent to a radially inside wall of the inner wall tool,

wherein said inner centre panel tool has a peripheral surface sloping axially inwardly in a radially outward direction from a central panel region of the inner centre panel tool, such that said peripheral surface together with said inside wall of the inner wall tool defines an annular recess axially inwardly of the central panel region, and

wherein said annular recess is configured to promote the formation of a radially outwardly extending bead in a can end during a reform process of axially compressing a blank against the inner centre panel tool.

16. The apparatus of Claim 15, wherein said peripheral surface is sloped relative to the axial direction across at least 25% of the radial width of said annular recess extending radially outwardly from said central panel region.

17. The apparatus of Claim 15 or 16, wherein an axially outwardly facing concave annular recess is formed at the radially outer edge of the peripheral surface of the inner centre panel tool, so as, together with the inside wall of the inner wall tool, to promote said formation of the radially outwardly extending bead during the reform process of axially compressing a blank against the inner centre panel tool.

18. The apparatus of Claim 15, 16 or 17, wherein said peripheral surface is convexly curved gradually axially inwardly away from the central panel region in the radially outward direction to form said slope as a domed convex annulus.

19. The apparatus of Claim 11, 12, 13 or 14, comprising tooling for manufacturing a can end to be double-seamed onto one axial end of a can body of a can, the tooling comprising:

inner tools for forming the can end on a side corresponding to the inside of the can and arranged to be disposed on an axially inner side of outer tools for forming the can end on a side corresponding to the outside of the can, including:

an or the inner centre panel tool;

an inner wall tool arranged concentrically surrounding and substantially adjacent to the inner centre panel tool;

an outer centre panel tool opposed to the inner centre panel tool; and

at least one outer wall tool generally opposed to the inner wall tool and arranged concentrically surrounding and substantially adjacent to the outer centre panel tool,

wherein the opposed inner and outer wall tools are able to move axially relative to the opposed inner and outer centre panel tools,

wherein the outer centre panel tool has a smaller outside diameter than the inside diameter of a radially inner wall of the inner wall tool, the outer centre panel tool being disposable concentrically at least partially within the inner wall tool to leave an annular gap radially surrounding the outer centre panel tool, and

wherein the inner centre panel tool includes a peripheral annular surface surrounding a central panel region of the inner centre panel tool and extending axially inwardly in a radially outward direction from the central panel region, the peripheral annular surface, together with the radially inner wall of the inner wall tool, defining an annular recess extending axially inwardly from the central panel region of the inner centre panel tool, said annular recess being substantially opposed to said annular gap.

20. The apparatus of Claim 19, wherein the peripheral annular surface terminates at its radially outer end in an annular recess configured to promote the formation of a radially outwardly extending recess during a reform process of axially compressing a blank against the inner centre panel tool.

21. The apparatus of Claim 19 or 20, wherein the at least one outer wall tool includes a chuck wall tool arranged concentrically surrounding and substantially adjacent to the outer centre panel tool and extending across the annular gap substantially opposed to the annular recess.

22. The apparatus of Claim 21, wherein the chuck wall tool includes an axially inwardly facing annular surface opposed to the annular recess, said inwardly facing surface being sloped axially outwardly in the radially outward direction. ~~the tooling of any one of Claims 30 to 37.~~

41. A can end manufacturing apparatus including:
the tool of any one of Claims 27 to 29; and/or
the tooling of any one of Claims 30 to 37.

42. A can end, the can end being configured to be joined by a peripheral annular joining portion to one axial end of a can body of the can and having an outer side arranged to face outwardly from the can and an inner side arranged to face inwardly into the can, the can end comprising:

an annular structure which is concave with respect to the outer side of the can end and is connected to:

a centre panel structure radially inside the annular structure; and

a chuck wall structure annularly surrounding the annular structure and extending axially- and radially- outwardly from the annular structure; and

a cover, label, token or tab, or other material, provided at least partially within the concave annular structure.

43. The can end of Claim 42, wherein the can end is for a can for pressurized contents and is arranged such that, when the can end is joined to a can body and internal pressure in the can is increased, the can end will be deformed such that wall portions at each side of the annular structure close on the cover, label, token, tab or other material provided in the concave annular structure.

44. The can end of Claim 42 or 43, wherein the cover, label, token or tab substantially encloses an opening of the can end to maintain a sterile or hygienic condition on the enclosed outer side surface of the can.

~~45. The can end of Claim 42, 43 or 44, wherein the cover, label, token or tab cooperates with or forms part of an opening and/or re-sealing feature of the can end.~~

~~46. The can end of Claim 42, 43, 44 or 45, wherein the cover, label, token, tab or other material is provided in the concave annular structure to provide reinforcement or to control the deflection and/or failure behaviour of the can end.~~